

New Species of Southern African *Moraea* (Iridaceae–Iridioideae), and the Reduction of *Rheome*

Peter Goldblatt

B. A. Krukoff Curator of African Botany, Missouri Botanical Garden, P.O. Box 299,
St. Louis, Missouri 63166, U.S.A.

John C. Manning

National Botanical Institute, P. Bag X7, Claremont 7735, South Africa

ABSTRACT. Two new species of the large African genus *Moraea* (125 species), *M. rivulicola* and *M. regalis*, both members of subgenus *Vieusseuxia*, are described here. *Moraea rivulicola* has cream to greenish flowers, unusually long capsules, and is a robust plant restricted to the banks and beds of seasonal streams in Namaqualand, in the north-western part of South Africa. *Moraea regalis* is known from one locality, near De Rust in the Little Karoo, South Africa. Both species occur in the semiarid winter rainfall part of southern Africa, a region known for the richness and diversity of its flora. The genus *Rheome*, now believed to be most closely related to species of *Moraea* subg. *Moraea*, is reduced to synonymy, and the three species of *Rheome* are transferred to *Moraea* as *M. maximiliani*, *M. nana*, and *M. umbellata*.

Over half of the estimated 1750–1800 species of the petaloid monocot family, Iridaceae, occur in southern Africa (Goldblatt, 1991, 1994). The area is well known botanically, yet despite more than 250 years of botanical exploration, novelties continue to be discovered there. Although the family is a significant element of the flora throughout the subcontinent, Iridaceae are most diverse in the southern and western parts of South Africa, a region of winter rainfall and summer drought. Two new species of *Moraea* are described here, both from this portion of southern Africa, and the genus *Rheome* is reduced to synonymy in *Moraea*. *Moraea* is the largest African genus of subfamily Iridioideae, and the central genus of Irideae–Homeriinae (Goldblatt, 1976, 1986a). At the last revising, Goldblatt (1986a) admitted 119 species to the genus. Since

then one species, *M. vlokii* (Goldblatt, 1992), has been described. With the addition of the two new species described here and three transferred from *Rheome*, there are now 125 species in the genus. According to the revised taxonomy, some 110 species of *Moraea* occur in southern Africa, that is, south of the Zambezi–Cunene axis, most of them endemic, and by far the majority restricted to the semiarid and arid southwestern portion of the region.

NEW SPECIES

1. *Moraea rivulicola* Goldblatt & J. C. Manning, sp. nov. TYPE: South Africa. Northern Cape Province: Namaqualand, Springbok District, streambed at the eastern end of Spektakel Pass, 11 Sep. 1993, Goldblatt & Manning 9710 (holotype, NBG; isotypes, K, MO, PRE, WAG). Figure 1A–D.

Plantae 50–80 cm altae, cormo globoso ca. 14–18 mm in diametro tunicis reticulatis, folio solitario lineare canaliculato ca. 10 mm lato, caule ramoso, floribus cremeis vel virescentibus vel pallide brunneis, tepalis exterioribus unguiculatis atropunctatis ad bases limborum 20–24 mm longis, limbis lanceolatis ca. 14 mm longis, unguibus canaliculatis 7–10 mm longis, tepalis interioribus 13–15 mm longis tricuspidatis, filamentis ca. 8 mm longis in columno ca. 5.5 mm longo connatis, antheris 4–5 mm longis, ramis styli ca. 6 mm longis, cristis 3–5 mm longis erectis, capsulis cylindricis 25–32 mm longis.

Plants 50–80 cm high. *Corm* globose, 14–18 mm diam., the tunics of pale, coarse vertical fibers connected by fine cross strands in herringbone pattern. *Cataphylls* usually dry and brown at flowering time, extending 5–10 mm above the ground. *Foliage leaf*

Figure 1. Morphology of *Moraea rivulicola* Goldblatt & J. C. Manning (Goldblatt & Manning 9710) and *M. unguiculata* Kew Gawler (Goldblatt & Manning 9711). *M. rivulicola*: —A. Corm and basal part of stem. —B. Upper part of stem. —C. Outer and inner tepal. —D. Capsule. *M. unguiculata*: —E. Leaf and upper part of stem. —F. Outer and inner tepal. —G. Capsule.





Figure 2. Distribution ranges of *Moraea rivulicola* (closed circles), *M. regalis* (open circle), and *M. unguiculata* (delimited by heavy lines).

solitary, basal, 2–2.5 times as long as the stem, channeled, 6–10 mm wide (when opened flat). *Stem* erect, consisting of 4(–5) internodes, straight and erect, the internodes 10–15 cm long, simple or with 1–3 branches, the branches held close to the axes, bearing an entirely sheathing bractlike leaf at each of the 3(–4) nodes, sheathing leaves 50–65 mm long, the apices attenuate-filiform. *Inflorescences* rhipidia, these single and terminal on each branch, several-flowered; *spathes* enclosing the rhipidia unequal, green, firm-textured, with dry brown attenuate apices, the outer ca. 45 mm long, the inner 55–67 mm long. *Flowers* cream, greenish or beige, with large nectar guides at the bases of the outer tepal limbs, these consisting of dark spots on a dull yellow field, the claws similarly dotted, both guide and outer tepal claws glabrous, inner tepals light to reddish brown, also densely spotted; *outer tepals* 20–24 × 10–13 mm, the claws ascending, channeled, 7–10 mm long, each with a large basal nectary, the nectary opposed by a lobe ca. 2 mm long, the limbs reflexed 45°–60° below horizontal, 14 × 10 mm; *inner tepals* 13–15 × 4–5 mm, the claws ascending, ca. 8 mm long, channeled, the margins usually partly conduplicate, the limbs trilobed, the median lobe linear, curving inward laxly and asym-

metrically coiled, lateral lobes broad and weakly defined, obtuse, 1–2 mm long. *Filaments* ca. 8 mm long, united in a cylindric column ca. 5.5 mm long, free and diverging in the upper 2.5 mm; *anthers* 4–5 mm long, each appressed to the opposed style branch, shortly exceeding the stigma lobes, orange. *Ovary* oblong-trigonous, 11–14 mm long, exerted from the spathes; *style* dividing at the apex of the filament column, the branches ca. 6 × ca. 2 mm, diverging, each with paired terminal lanceolate crests 3–5 mm long. *Capsules* cylindric, 25–32 mm long; *seeds* angular, only known in the immature state.

Flowering mid August to late September.

Etymology. From the Latin *rivulicola*, “living in streams,” referring to the specialized habitat of the species.

Distribution and habitat. *Moraea rivulicola* is a fairly rare endemic of northern Namaqualand, Northern Cape Province, South Africa. It extends from the Spektakel Mountains west of Springbok southward to the Kamiesberg (Fig. 2). Plants appear to be restricted to the beds of seasonal streams and along drainage lines, usually with their corms deeply wedged in crevices in the granite bedrock. Re-

cords are all from areas of fairly high elevation, and for Namaqualand, relatively high rainfall.

Although *Moraea rivulicola* was first collected in 1883 by Harry Bolus and in the past was thought to be no more than a large-flowered variant of the widespread and fairly common *M. unguiculata* Ker Gawler (Goldblatt, 1976, 1986a), field observations in Namaqualand in 1993 and 1994 show that this treatment is incorrect. At two sites some 100 km apart, *M. rivulicola* was found growing along and in small seasonal streams, while fairly typical *M. unguiculata* grew on adjacent well-drained slopes. Seen at the same time and in quite different habitats, it became evident that these were different species, not merely ecotypes or local variants of a single polymorphic one. Critical comparison of living plants showed that not only is *M. rivulicola* more robust vegetatively, and has larger flowers, but that there are several critical qualitative differences between it and *M. unguiculata*.

The flowers of *Moraea rivulicola* (Fig. 1A–C) are cream with a pale greenish or beige tinge, and the outer tepals are ca. 24 mm long with the limbs typically held at 60° below the horizontal. The nectar guides, located at the base of the tepal limb, are whitish covered with small dark brown to blackish spots, and both the nectar guide area and the tepal claws are smooth. The inner tepals are also distinctive: the central lobe of the tripartite limb is drawn into a slender obliquely coiled cusp, while the lateral lobes are obtuse and very short. The claws of the inner tepals are channeled and the margins are partly conduplicate, thus forming a nearly closed tube. The ovary is oblong-cylindrical and 11–14 mm long, and gives rise to cylindrical capsules 25–32 mm long. Ripe seeds are unknown, but are probably larger than those of *M. unguiculata*. *Moraea unguiculata*, both in Namaqualand and elsewhere across its range, has smaller flowers with the outer tepals seldom exceeding 16 mm (Fig. 1E–G). Larger dimensions for the species given by Goldblatt (1976, 1986a) included plants now referred to *M. rivulicola*. The tepal limbs in Namaqualand populations of *M. unguiculata* are 8–10 mm long, and are held slightly below the horizontal, or flexed up to 45°, but in populations in the southern Cape, the limbs may be fully reflexed. Both the small nectar guide area and the outer tepal claws are densely pubescent. The inner tepals are 7–10 mm long, and also tripartite. The central cusp is long and symmetrically coiled inward, but the outer lobes are relatively longer and more distinctly formed than in *M. rivulicola*, and may be subacute. The inner tepal claws are more or less terete or slightly flattened on the adaxial surface. Flower col-

or in *M. unguiculata* varies, ranging from pure white to cream, brownish, and even blue, and floral form (but not size) is unusually plastic (Goldblatt, 1986a). The outer tepal limbs may extend outward or, in some populations outside Namaqualand, may be completely reflexed.

The distinctive pale green leaves of *Moraea rivulicola* are relatively long, sometimes up to 2.5 times as long as the stem, thus over 1 m in length, broadly channeled, and 6–10 mm wide. The stems are 4–5 internodes long and bear 3–4 sheathing leaves 50–65 mm long. Leaves of *M. unguiculata* are darker gray-green, shorter, seldom more than a third again as long as the stem, and they are narrowly channeled, 2–3(–4) mm wide. The stems are 3 internodes long and bear 2 sheathing leaves 40–55 mm long. Thus the two species differ both in leaf and stem morphology as well as in floral structure.

Differences in the leaf texture and venation of the two species reflect notable anatomical differences (Fig. 3). In transverse section the leaf of *Moraea unguiculata* (Fig. 3B) is relatively thin. The heavily sclerified sheaths of the major bundles touch those of the opposing minor bundles and there is a large strand of subepidermal marginal sclerenchyma, not apparently associated with a vascular bundle (although a small central cavity suggests the presence of minor veins in early ontogeny). In comparison, the leaf of *M. rivulicola* is much thicker in transverse section (Fig. 3A), the sheaths of the major bundles are less heavily sclerified and the opposing minor bundles are well separated from them, and most significantly, there is a small marginal vein with a small sclerified phloem cap. These differences in leaf anatomy between the two species are of the kind most commonly associated with xeric versus more mesic habitats.

Habitat differences between *Moraea rivulicola* and *M. unguiculata* appear to be absolute. The latter grows on open exposed rocky sites, or on stony slopes, in both cases in well-drained and often arid situations. *Moraea rivulicola* has, however, so far only been found in seasonally wet habitats, waterlogged or even inundated for part of the growing season. In Namaqualand *M. unguiculata* may be found either on soils derived from shale, as in the Spektakel Mountains or near Steinkopf (Goldblatt, 1986a), or on granite-derived soils. *Moraea rivulicola* has only been found on pockets of granite-derived sand in rocky granite on the banks or in the beds of streams.

Both *Moraea rivulicola* and *M. unguiculata* belong to subgenus *Vieusseuxia*, members of which share the following synapomorphies: long-lasting flowers, a solitary foliage leaf, distinctive reticulate

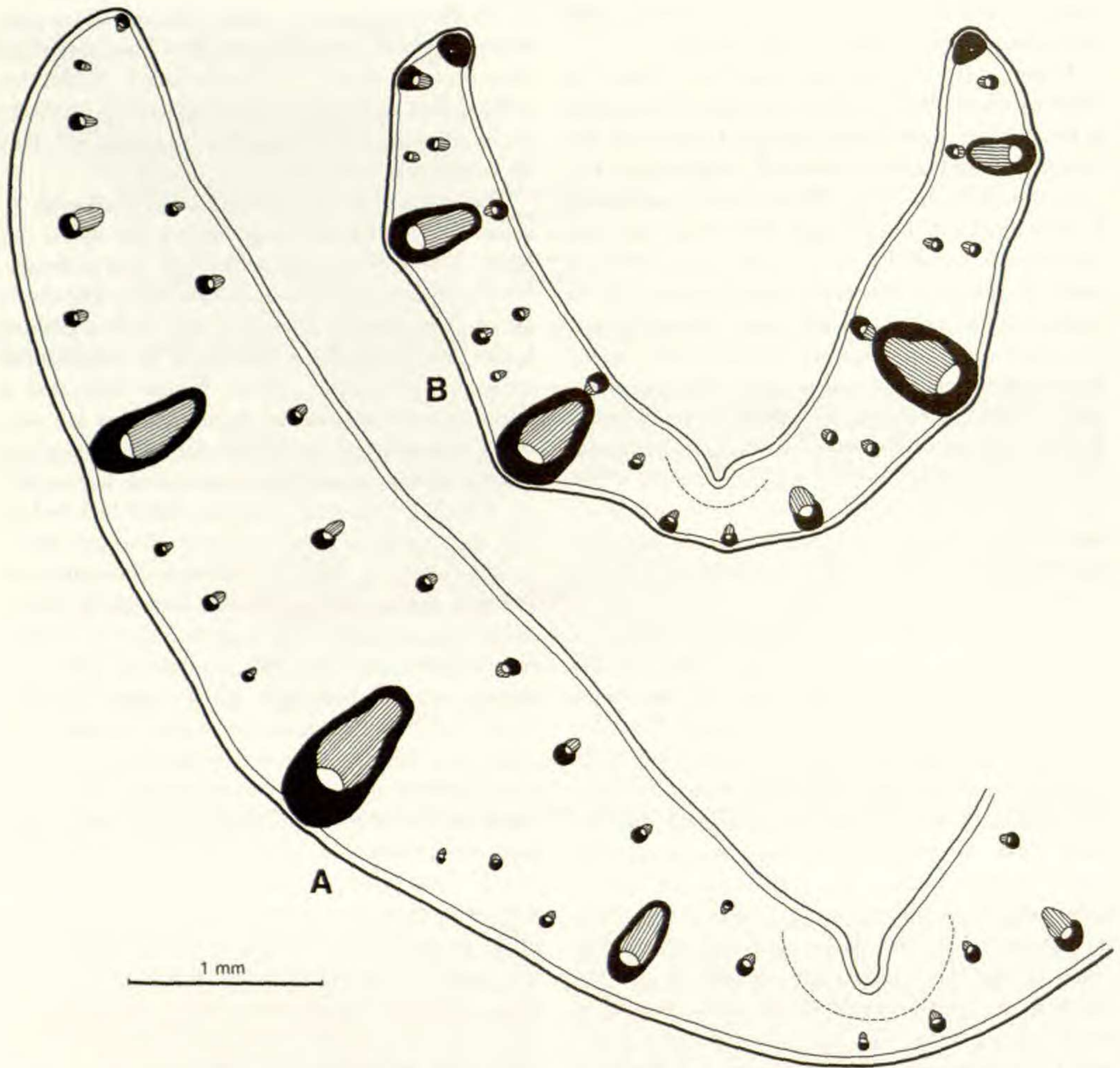


Figure 3. Transverse sections of leaves of *Moraea rivulicola* (A) and *M. unguiculata* (B). Solid black = sclerenchyma; hatching = xylem.

corm tunics composed of pale, soft-textured fibers, and an asymmetric karyotype with $x = 6$. Within the subgenus, *M. rivulicola* and *M. unguiculata* appear to be allied to those species that have similar trilobed inner tepals, inconspicuous nectar guides, and a long filament column. Other species in the alliance include the southwestern Cape species *M. tricuspdata* (L. fil.) G. Lewis and *M. bellendenii* (Sweet) N. E. Brown, and the eastern southern African *M. trifida* R. Foster, *M. pubiflora* N. E. Brown, and *M. brevistyla* (Goldblatt) Goldblatt.

Paratypes. SOUTH AFRICA. **Northern Cape:** 2917 (Springbok) 22 km W of Springbok, eastern slopes of Spektakel Mountains, in streambed (DA), 26 Sep. 1974, *Goldblatt 2791* (MO, PRE); streambed at the eastern end of Spektakel Pass, 4 Sep. 1994, *Goldblatt & Manning 9971* (MO, NBG); rocky places near Modderfontein (DB),

Sep. 1883, *H. Bolus 6618* (BOL). 3018 (Kamiesberg) eastern slopes of Rooiberg, ca. 1050 m (AC), 14 Oct. 1976, *Goldblatt 4313* (MO, PRE); Kamiesberg Mountains, farm Welkom, streambed near the top of Langkloof, 14 Sep. 1993, *Goldblatt & Manning 9770* (MO).

2. *Moraea regalis* Goldblatt & J. C. Manning, sp. nov. TYPE: South Africa. Western Cape: Little Karoo, De Rust, rocky hillside near old cemetery, 19 Sep. 1994, *J. A. Vlok & A. L. Schutte 345* (holotype, NBG; isotypes, K, MO, PRE, WAG). Figure 4.

Plantae 18–25(–35) cm altae, corno globoso 12–14 mm in diametro tunicis reticulatis, folio solitario lineare canaliculato, caule eramoso, floribus violaceis, tepalis exterioribus albis notatis unguiculatis (26–)30–40 mm longis, limbis lanceolatis 13–20 mm longis, tepalis interioribus 20–24 mm longis erectis saepe unguiculatis et limbis tri-



Figure 4. Plant and flowers of *Moraea regalis* Goldblatt & J. C. Manning (Vlok & Schutte 345). Note old corm tunics persisting around the stem and no longer at the base of the plant.

cuspidatis, filamentis 12–15 mm longis connatis in columno 9–10 mm longo, antheris 6–9 mm longis, ramis styli 10–12 × 2 mm divergentibus, cristis anguste lanceolatis vel linearibus 5–8 mm longis.

Plants 18–25(–35) cm high. *Corms* globose, 12–14 mm diam., the tunics of medium to coarsely textured reticulate fibers, light brown. *Cataphylls* dry and brown at flowering time. *Foliage leaf* solitary, basal, half again to twice as long as the stem, linear and canaliculate, ca. 3 mm wide (when opened flat), upright below, trailing above. *Stem* erect, 3 internodes long, straight and erect, unbranched, the lowermost internode shortest and the uppermost longest, bearing an entirely sheathing bractlike leaf at each node, these 25–40 mm long, the apices attenuate. *Inflorescence* a single, usually 2-flowered terminal rhipidium; enclosing spathes unequal, green, firm-textured, with dry brown attenuate apices, the outer 25–40 mm long, the inner 45–65 mm long. *Flowers* violet, the limbs of the outer tepals each marked at the base with a small white triangular nectar guide outlined with a dark purple zone, the base of the outer tepal limb minutely pubescent, the claw heavily pubescent, the hairs dark violet, evidently without nectar, scentless; *outer tepals* (26–)30–40 mm long, the claws ascending, 12–16 mm long, with a smooth deltoid zone at the base, evidently a vestigial perigonal nectary, the limbs 13–20 mm long, directed downward at right angles to the ground; *inner tepals* erect and ± linear to slightly wider just below the midline, thus obscurely clawed, 20–24 mm long, the claw ca. 12 mm long, the limb aristate or occasionally tricuspidate, then the lateral lobe 1–2 mm long, and central cusp ca. 10 mm long. *Filaments* 12–15 mm long, united below in a cylindric column 9–10 mm long, free and diverging in the upper 3–5 mm; *anthers* 6–9 mm long, each appressed to the opposed style branch, just shorter than or just exceeding the stigma lobes, the pollen orange. *Ovary* oblong-trigonous, 8–10 mm long, usually fully exerted from the spathes, style dividing just above the apex of the filament column, the branches 10–12 × 2 mm, diverging, each with paired terminal, narrowly lanceolate to linear crests 5–8 mm long. *Capsules* ovoid-oblong, 12–16 mm long; *seeds* angular and prismatic, ca. 1.5 mm long.

Flowering mid August to mid September.

Etymology. From the Latin *regalis*, “royal,” referring to the dark blue-purple or violet color of the flowers.

Distribution and habitat. *Moraea regalis* appears to have been collected for the first time in 1993, when it was found near the Little Karoo town

of De Rust (Fig. 2). So far it is known only from a single locality, south-trending slopes of a rocky hill south of De Rust. The substrate is sandy soil derived from Enon Conglomerate.

Like *Moraea rivulicola*, described above, *M. regalis* is a typical member of subgenus *Vieusseuxia*. It is distinguished in the genus and subgenus by the striking dark violet flower color, the relatively large flower size with the outer tepals 26–40 mm long, the long tepal claws, and the narrow, either aristate and more or less linear or tricuspidate inner tepals (Fig. 4). Its affinities lie with *M. unguiculata* and *M. algoensis* Goldblatt, both of which have smaller flowers and trilobed inner tepals with a large incurved central cusp and small but broadly obtuse lateral lobes. The slender filament column and narrow style branches are also typical of this group of species.

Paratype. SOUTH AFRICA. **Western Cape:** 3322 (Oudtshoorn) Little Karoo, De Rust, hill S of the town, stony S-facing slopes (BC), Sep. 1993, J. A. Vlok & A. L. Schutte s.n. (MO).

REDUCTION OF *RHEOME* GOLDBLATT

The genus *Rheome* was erected by Goldblatt (1980) to accommodate two species of *Homeria*, *H. umbellata* (Thunberg) G. Lewis and *H. maximiliani* Schlechter. These differed from other species then included in *Homeria* in their brown, nonreticulate corm tunics, apically diverging outer inflorescence spathes, and apically crowded rhipidia (inflorescence units) on the stem. The remaining species of *Homeria* have reticulate corm tunics composed of coarse black fibers, sheathing outer rhipidial spathes, and rhipidia that are not crowded apically. The basic chromosome number also differs in the two groups. Species of *Homeria* have $x = 6$, and secondarily $2n = 10, 9$, or 8 , whereas *H. umbellata* and *H. maximiliani* have $x = 10$, considered to be the plesiomorphic chromosome number for Homeriinae (Goldblatt, 1976, 1980; Rudall & Goldblatt, 1993). Moreover, a series of crossing experiments showed that although most of the species of *Homeria* could be crossed with one another, none could be crossed with *H. maximiliani*. The latter, however, could be crossed with one species of a second genus *Hexaglottis*, *H. nana* L. Bolus, which also has the corm tunics, rhipidial spathes, and arrangement of the rhipidia characteristic of *Rheome*. Neither *Homeria maximiliani* nor *Hexaglottis nana* could be crossed with a selection of species of *Hexaglottis*. It was evident on the basis of morphological, cytological, and crossing evidence that *Homeria umbellata*, *H. maximiliani*, and *Hexaglottis*

nana were a monophyletic group parallel to *Hexaglottis* and *Homeria* and that the close floral similarity to the latter two genera was due to convergence, most likely through the parallel reduction of the more complex *Moraea*-type flower, plesiomorphic in subtribe Homeriinae in its dimorphic inner and outer tepals and narrow style branches either bearing a reduced crest or lacking them entirely.

What was not evident when *Rheome* was described was that the distinctive corm tunics, inflorescence spathes, and arrangement of rhipidia characteristic of that genus have a parallel in *Moraea longiflora* Ker Gawler (subg. *Moraea* sect. *Tubiflora*). The second species of section *Tubiflora*, *M. cooperi* Baker, also has brown, nonreticulate corm tunics, but it has entirely sheathing rhipidial spathes and laxly disposed rhipidia. Basic chromosome number in subgenus *Moraea* is $x = 10$, which also accords with the number in *Rheome*. The discovery of *M. linderi* Goldblatt (Goldblatt, 1982) provided the missing link between *Rheome* and *Moraea*. This species has a flower typical of *Moraea*, having large outer tepals with conspicuous nectar guides, narrow inner tepals, broad style branches with paired petaloid crests, and a transverse stigma, but corms, corm tunics, rhipidial spathes and rhipidial arrangement of the type characteristic of *Rheome*, and a basic chromosome number of $x = 10$ (Goldblatt, 1986b).

Finally, a phylogenetic study of subtribe Homeriinae (Rudall & Goldblatt, 1993), using several leaf anatomical characters as well as morphology and chromosome cytology, provided evidence that *Rheome*, *Moraea* sect. *Tubiflora*, and two other species of section *Moraea*, *M. linderi* and *M. margaretae* Goldblatt, comprise a clade. The study did not include enough species to show, with any degree of confidence, the species or section most closely allied. Nevertheless, the evidence now available makes it clear that the species of *Rheome* and *Hexaglottis nana* are nested within a small clade of species of *Moraea* subg. *Moraea*. Under these circumstances, continued recognition of *Rheome*, a small genus nested within a section of the large and diverse *Moraea*, is clearly inconsistent with modern phylogenetic classification (Hennig, 1966; Donoghue & Cantino, 1988). We therefore propose to synonymize *Rheome* in *Moraea*. As noted above, *Rheome*, *H. nana*, *M. linderi*, and *M. margaretae* comprise a clade with the following apomorphic characteristics: nonreticulate, brown corm tunics; apically diverging outer rhipidial spathes, and a tendency for the crowding of rhipidia and foliage leaves near the stem apex. Some of these characters

are also shared by the members of section *Tubiflora* which, in addition, have the tepals united in a tube, apomorphic in *Moraea*. The absence of some of the above synapomorphies in *M. cooperi* is puzzling, and we suspect may be due to character reversal. The taxonomy of species transferred to *Moraea* is outlined below.

1. ***Moraea maximiliani*** (Schlechter) Goldblatt & J. C. Manning, comb. nov. Basionym: *Homeria maximiliani* Schlechter, Bot. Jahrb. Syst. 27: 94. 1900. *Rheome maximiliani* (Schlechter) Goldblatt, Bot. Not. 133: 92. 1980. TYPE: South Africa. Western Cape: Hoek, Clanwilliam District, Schlechter 8700 (lectotype, designated by Goldblatt (1980), B; isotypes, BOL, K, MO, S).
2. ***Moraea nana*** (L. Bolus) Goldblatt & J. C. Manning, comb. nov. Basionym: *Hexaglottis nana* L. Bolus, Kew Bull. Misc. Inf. 1932: 326. 1932 [1933]. TYPE: South Africa. Western Cape: Clanwilliam District, without precise locality, Weintraub s.n. (holotype, BOL 19972).
3. ***Moraea umbellata*** Thunberg, Dissertatio de *Moraea* no. 16. 1787. *Homeria umbellata* (Thunberg) G. Lewis, J. S. African Bot. 14: 86. 1948. *Rheome umbellata* (Thunberg) Goldblatt, Bot. Not. 133: 92. 1980. TYPE: South Africa. Western Cape: near Piketberg, Thunberg s.n. (holotype, Herb. Thunberg 1230 at UPS).

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